EAST SEARCH 09/876218
TAGGED - READ ALL ... Stephen

	Document ID	Title
1	US 5255184 A	Airline seat inventory control method and apparatus for computerized airline reservation systems
2	US 5404291 A	Inventory control process for reservation systems
3	US 5897620 A	Method and apparatus for the sale of airline-specified flight tickets
4	US 5918209 A	Method and system for determining marginal values for use in a revenue management system
5	US 6061691 A	Method and system for inventory management
6	US 6085164 A	Apparatus and method of allocating flight inventory resources based on the current market value
7	US 6263315 B1	Revenue management system and method
8	WO 9725684 A1	METHOD AND SYSTEM FOR DETERMINING MARGINAL VALUES FOR USE IN A REVENUE MANAGEMENT SYSTEM
9	US 5918209 A	Determining marginal values for use in revenue management system - loading perishable resource data into revenue management system, and determining marginal values using iterive function which are stored in revenue management system
10	US 6061691 A	Inventory management method for receiving customer request for inventory item involves creating table of inventory items that most closely correspond to customer request using price forecasting system and selecting item from table

read

	Document ID	Title
11	WO 200052605 A	Target pricing system for obtaining optimum bid value for goods and services, has market response model which computes probability of obtaining optimum price value by designating product value as function of price
12	US 6336097 B	Constructing travel fares involves constructing data structures after determining set of travel fare components to construct travel fare component combinations between origin and destination cities
13	US 20020120492 A	Event revenue management system e.g. for hockey game, updates initial forecast statistics generated by analyzing historical data with initialized forecast parameter, based on current data, to optimize event prices
14	US 20020065699 A	Computer implemented revenue management in airlines, involves applying control values generated using discrete choice model to resource management control system to define set of choices and attributes of resource units
15	US 20010051932 A1	Method and system for dynamic pricing
16	US 20030208436 A1	Interactive demand management

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	2	("5797127").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/10 22:02
S2	0	("5918209,6061691").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 14:28
S3	4	(("5918209") or ("6061691")).PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 14:28
S4	4	(("6078893") or ("6182048")).PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 14:28
S5	2	("20020120492").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:40
S6	1	fractional adj build adj (curve or curves)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:40
S7	170	(revenue or yield or pricing or price) adj management adj system	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:57
S8	96	S7 and @ad<"20010608"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:43

S9	915	(inventory or demand) adj management adj system	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:58
S10	363	S9 and @ad<"20010608"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:58
S11	354	S10 not S8	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/03 22:59
S12	4	(talus and solutions).as.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/04 11:08
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S14	2	("2000210354").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/04 20:21
S15	0	("dynamicadj(priceorpricing)").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/06 00:14
S16	337	dynamic adj (price or pricing)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/06 00:14

S17	68	S16 and (airlines or airline)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/06 00:15
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S19	2	("6308201").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/08 14:11
S20	2	("6381632").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/08 14:19
S21	0	("cplexandilog").PN.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/08 14:19
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S26	1	(aggregate or aggregating) adj (historic or historical or past or previous) adj (information or data) and forecast	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2005/07/10 22:03
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S33	11	("5404291").PN. OR ("5918209"). URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2005/07/11 08:36

Dialog search: 09/876218 Event Revenue Management System / Phillips et. Al.

Set Items Description

S1 5 (FRACTIONAL OR FORECAST)(1W)BUILD(1W)(CURVE OR CURVES)

1/19/1 (Item 1 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)

02026875 54170959
Forecasting for airline revenue management
Zaki, Hossam
Journal of Business Forecasting Methods & Systems v19n1 PP: 2-6 Spring 2000 ISSN: 0278-6087 JRNL CODE: JBT
DOC TYPE: Periodical; Feature LANGUAGE: English RECORD TYPE: Fulltext
LENGTH: 4 Pages
WORD COUNT: 2865
GEOGRAPHIC NAMES: United States; US
DESCRIPTORS: Revenue; Forecasting techniques; Airline industry; Accuracy
CLASSIFICATION CODES: 3100 (CN=Capital & debt management); 8350

(CN=Transportation & travel industry); 9190 (CN=United States)

PRINT MEDIA ID: 14886

ABSTRACT: How revenue management is used in the airline industry is described. RM cannot work without adequate forecasts of capacity, demand and prices. Improvement in forecast accuracy significantly improves revenue. Revenue management techniques are essentially a set of balancing acts, each act or technique adds a small fraction to the airline revenue, and collectively they provide respectable increases. TEXT: Describes how revenue management system is used in the airline industry to optimize profit.. RM cannot work without adequate forecasts of capacity, demand and prices .:. improvement in forecast accuracy significantly improves revenue ... details all the challenges that the airline industry faces.

It is a common knowledge that the purpose of the airlines industry is to profitably move people from one airport to another. Although on the surface it looks very simple, it is very difficult to do it. Airlines have to make strategic and operational decisions, considering numerous factors and forecasts. Strategic decisions include such things as how many aircraft to buy (fleet sizing) and where to fly (network structure). These decisions are called strategic because they have a long-term impact on all aspects of the airline business, and they are costly to change. Elaborate market share projections and long-term demand forecasts are important inputs for such decisions. There are many cases where airlines got bankrupt because of ill-conceived strategic decisions.

Airlines also have to make numerous operational decisions on a daily basis. Some of the most financially rewarding operational decisions are made using revenue management techniques. As Robert Crandall, former Chairman and CEO of AMR and president of American Airlines, puts it, "Revenue management is the single most important technical development in transportation management since we entered the era of airline deregulation in 1979." In this article we will focus on the airline revenue management techniques and the supporting forecasts.

WHY FORECAST?

To address this question, we present a brief overview of what is revenue management in the airline industry. Then, we will highlight the importance of revenue management and forecasting accuracy.

REVENUE MANAGEMENT

The short answer to the question, "why forecast," is to support revenue management (RM). So, what is revenue management? The main objective of RM is to sell the right seat to the right customer at the right time for the right price to maximize profit. To achieve this, the airlines need to sell the optimum product mix. On the surface it might seem that the airlines sell one product, which is a seat on an airplane going from point A to point B. In fact, an airline sells numerous products. A single flight may have hundreds of fares each is associated with only one product. The underlying premise of the practice of revenue management is that there exists an optimum mix of products that can maximize the airline's profit. The mechanism the airlines use to capture this optimum product mix is simply the accept/reject decision made by the airline reservations system. It is important to note that this mechanism does not require adding new airplanes nor does it require adding more flights. It does not create additional demand and does not change the current prices. Instead, it strives to match the passengers' demand with the airline's supply of seats in such a way that maximizes the airline's profit from existing assets. The accept/reject decisions are typically based on the results of solving one or more optimization problems, collectively called the revenue management problem. The fundamental data components of the revenue management problem are price, demand and capacity. Forecasting helps to estimate these components.

FINANCIAL IMPACT

Revenue management significantly adds to the airlines' income. According to Robert Crandall, RM adds $500 millions a year to the income of American Airline. It adds about $100 millions to the income of United Airlines (UA). In general, airlines realize additional income as a result of RM anywhere between 1 % and 10%. Forecasting accuracy plays a very important role in realizing income from the RM system. Studies show that a 10% reduction in forecast error increases revenue by 0.5%, $80 millions additional revenue a year for a $16 billion airline e.g. American Airline. America West has also reported similar results where a 25 % reduction in the error increased revenue by 1.4%.

RM TECHNIQUES

Revenue management techniques are essentially a set of balancing acts, each act or technique adds a small fraction to the airline revenue, and collectively they provide respectable increases, between 1 % and 10%. Here is a brief overview of some of the most important balancing acts performed by revenue management.

Overbooking: Passengers sometimes cancel their reservations, and other times they do not show up at all at departure time. Hence, if the airline sells 100 seats on a 100-seat flight, the airline will end up with unoccupied seats. An unoccupied seat on a flight is lost revenue that cannot be recovered. Hence, the airline has to overbook. That is, the airline has to sell more seats than the actual physical capacity to account for cancellations and no shows. However, we cannot overbook extensively. If we overbook too much, there will be more passengers showing up at the gate than seats available in the aircraft. In that case, the airline has to compensate with a voucher to passengers that will be denied boarding. Thus, the first balancing act of RM is to determine optimum overbooking limit, that is, how many seats to sell for every departure to account for cancellations and no shows.

Discount Allocation: Airlines sell discount fare tickets usually to price sensitive leisure travelers and full fare tickets to price insensitive, late-booking business travelers. The demand for discounted seats often exceeds capacity. If an airline does not protect seats for the late booking, then the revenue from high revenue business travelers will be lost. On the other hand, selling full fare tickets alone will not fill up the airplanes, thereby the airline will lose its market share to competitors' discount fare flights. Hence, the second balancing act of RM is to determine how many seats to sell at a discount fare and how many to save for high revenue passengers.

Origin-Destination Management: Airlines with hub and spoke structure have to distinguish between long haul and short haul traffic (passengers). A simple example is to consider 2 flights. Flight # 1 is from city A to city B. Flight # 2 is from city B to city C. In this example, passengers who fly from A to B to C are called long haul passengers (or traffic). Passengers who fly only from A to B are called short-haul passengers. Also, passengers who fly only from B to C are called short-haul passengers. Obviously, long haul passengers are competing with short haul passengers on the seats of both flights. Airlines with hundreds of flights in and out of each hub every day have to determine the optimum seat allocation between short and long hauls that will maximize their profit. This "optimum" seat allocation, of course, depends on demand and price of all itineraries involved. Typically, long haul traffic yields higher revenue. Hence, the third balancing act of RM is to determine how many seats to sell to short haul passengers and how many to save for high revenue, long haul passengers.

Group Management: Travel agencies, tour operators, consolidators and wholesalers frequently request a reservation of a group of passengers. Sometimes, the group booking is a onetime ad-hoc request. Other times, it is a sequence of bookings, identical in every respect except the departure day. Wholesalers usually buy blocks of seats for every schedule. Groups are an attractive option for airlines because they can fill empty seats on low-demand flights, and because they generally book earlier than individuals. Due to their size and early booking pattern, groups request fares are lower than individual discount fares. The choice between groups and individuals is the fourth balancing act, which RM has to perform. Here, the airlines have to determine how many seats to sell to groups at what price so that adequate numbers of seats are left for higher revenue, later booking customers. An important attribute of group-booking fares is that they are typically negotiated, this complicates the group accept/reject decision and necessitates adding additional modules to the RM system for group revenue management.

Point of Sale Management: Managing ticket distribution is of significant importance to the airlines' bottom line. Traditional sales channels such as travel agencies and airlines ticket offices are now challenged with new Internet channels such as airline web sites (e.g. Travelocity) and auction or bid sites (e.g. Priceline). Before the Internet era began, many airlines distribution costs were up to 20 % of the price of a ticket. Currently this number is around 16%. Airlines are striving to get it down to as low as 6% using smarter methods to control the volumes allocated to different sales channels. Although commission fee is the main component of distribution costs, currency stability is also an important concern for international tickets. Airlines have to account for currency fluctuations. As such, it limits the sales made in less stable foreign currencies.

WHAT TO FORECAST As stated above, we need to forecast capacity, demand and prices. By far demand forecasting is the most challenging part. Capacity forecast would have been a straightforward exercise if it were not for cancellations and no shows. Prices would also have been much simpler if the price data was available with the booking requests.

DEMAND

Similar to any other industry, the airline industry forecasts demand for each product it sells. In fact, the airlines created these products in order to increase its revenue. To support revenue management, mean and variance of each product demand are needed. For RM purposes, the main attribute that defines a product is that it has one price (i.e. fare). Factors that affect airline fares include time of purchase, trip's origin -destination, one way or round trip, individual or group, season, time of day, day of week, Saturday stay over, point of sale and membership of the airline's frequent flyer program. At any point of time, each combination of these attributes can represent a single product with a single price. As such, mean and variance for each product demand are required.

BOOKING PROFILES The airline industry is one of very few industries that have a unique asset in forecasting product demand. That asset is the reservation data. Typically, most airlines open a flight for bookings almost one year before departure, and during that time useful reservation data is accumulated. The time between starting to accept bookings and flight departure is called the booking horizon. A booking profile (or a booking pattern or a fractional build curve) is a chart that depicts the percentage of bookings over the booking horizon of a flight. Almost all RM forecasting modules assume that one or more attributes of historical booking profiles will repeat in the future. This fundamental assumption plays an important role in projecting the future demand and guiding the essential accept/reject decisions during the booking horizon of each flight.

SHOW-UP RATES

Show-up rate is the ratio between number of passengers who will show up at the time of departure to the total number of bookings at any point in the flight's booking horizon. The show-up rate can be an attribute of a flight or a product. In general, a flight show-up rate deviates from 100% due to one of three reasons: cancellations, no shows and walk-ins. Cancellations are no-shows with a notification before departure. Walk-ins are passengers who want to board the flight and have no prior reservation. Estimates of these three rates are required to determine overbooking.

FARE FORECAST

One of the most surprising aspects of airline booking data is its lack of price data. That is, when a reservations system receives a booking request, say from a travel agent, it does not specify the dollar amount associated with the request. RM systems are hence forced to forecast the fare associated with each booking request using historical coupon (ticket) data of similar bookings.

CHALLENGES

Compared to many other industries, the passenger airline industry has the best data in terms of volume, length of history and quality. Despite these, it faces many challenges which we will describe next.

DYNAMIC NATURE OF RM

If all data components, demand, supply and price are static and known in advance, the problem will be reduced to an integer program that can be solved using off-the shelf solvers. However, in practice, there are many challenges. One challenge is thedynamic nature of the problem. For example, in the airline industry, price for a certain product can change several times a day in response to competition. Another example is that customer demand and showup rates are at best stochastic and cannot be easily modeled using only the mean.

RESERVATIONS SYSTEMS LIMITATIONS

There are numerous examples of how the limited capabilities of the current airline reservation systems affect the ability of an airline to realize full potential of revenue management. The issue on hand is the availability, quality and stability of the problem data in electronic form. The magnitude of this challenge changes from one airline to another depending on the sophistication of the airline's reservation system. Herewe give few examples that are directly related to forecasting.

Most reservations systems store only data on accepted bookings and do not store historical information about rejected demand. RM requires projections of total untruncated demand as well as what was accepted.

Some reservation systems do not carry point of sale data with a booking request. This weakens the effectiveness of managing revenue by distribution channel.

Most reservations systems do not carry fare data with a booking request. As mentioned above, this makes RM systems to forecast fares and then add the risk of fare with a forecasting error.

Some reservations systems store demand history only by flight legs (nonstop flights between 2 points), not by the journey's origin and destination (OD). This makes origin-destination management much more difficult. For example, a flight from Dallas to Chicago may have passengers with numerous OD's, e.g. Houston to Chicago through Dallas, Dallas to London through Chicago, Dallas to Toronto through Chicago, and so on. But the reservation system provides information only on the number of passengers on a specific flight from Dallas to Chicago and not on the number of passengers by OD.

Some reservations systems cannot control round trips. All data is one-way based. This makes it difficult to differentiate between one-way and round trips.

SCHEDULE CHANGE

Most carriers have 2 major schedule changes (summer and winter) a year. These changes affect a significant percentage of the flights that is estimated to be between 10% and 20 %. There are several possible schedule changes:

Change in time of departure

Splitting a flight of one big airplane into two flights in smaller airplanes

Adding a new flight

Changing a flight number

If not treated properly, schedule change affects demand forecast accuracy in a negative way. The new schedule for which we need to forecast demand is different from the old schedule for which we have historical data. The challenge is to relate the demand for the current schedule to that of the old schedule.

PROBLEM SIZE

The number of forecasts required depends on the number of products and legs. For every product, we need mean and variance of the product demand and associated fare. For each leg, we need capacity. Depending on the overbooking model used,we need show-up rates either by leg or product.

Large airlines can have millions of products to forecast. In March 1998, United, the largest airline in the world, has announced its new $18 million demand forecasting system, dubbed Orion. The system supports origin-destination (OD) forecasting. Previously, United used its MVS mainframe to run its leg forecasting system. But when the airline wanted to analyze data more thoroughly at the OD level, the mainframe couldn't keep up. Due to a significant increase in the size of problem, United turned to parallel processing, and chose a RS/6000 SP2 system from IBM Corp with 47 processors that can be expanded to 512 processors and can even be linked to a second RS/6000.

CONCLUSIONS

Forecasting is an important component of airlines' revenue management. To support revenue management techniques, airlines have to forecast demand, supply and fares accurately. Forecast accuracy has a direct impact on the airline's bottom line. However, there are many challenges to achieve the desired level of accuracy. Revenue management researchers and analysts are developing new solutions to face these challenges.

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Viswanathan, Vish. "Demand Forecasting." AGIFORS Reservations and Yield Management Study Group. April 1999. HOSSAM ZAKI

Dr. Zaki is Solutions Director at Unisys Worldwide Transportation where he is responsible for revenue management applications. Before joining Unisys, he worked for SABRE in the Cargo and Logistics Group. He is also an adjunct professor at Southern Methodist University where he teaches graduate courses in Operations Research and Nonlinear Optimization. He holds a B.Sc. in Mechanical Engineering and M.Sc. and a Ph.D. in Operations Research.

1/19/3 (Item 1 from file: 349)
DIALOG(R)File 349:PCT FULLTEXT

00864398
EVENT REVENUE MANAGEMENT SYSTEM
SYSTEME SERVANT A GERER LES RECETTES D'UN EVENEMENT
Patent Applicant/Assignee:
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Legal Representative:
JIMENEZ CROWSON Celine (et al) (agent), Hogan & Hartson, LLP, 555 13th Street, NW, Washington, DC 20004-1109, US,
Patent and Priority Information (Country, Number, Date):
Patent: WO 200197135 A2 20011220 (WO 0197135)
Application: WO 2001US18530 20010608 (PCT/WO US0118530)
Priority Application: US 2000210354 20000609

Designated States:

(Protection type is "patent" unless otherwise stated - for applications prior to 2004)

AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW (EP) AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR (OA) BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG (AP) GH GM KE LS MW MZ SD SL SZ TZ UG ZW (EA) AM AZ BY KG KZ MD RU TJ TM

Main International Patent Class: G06F-017/60
Publication Language: English
Filing Language: English
Fulltext Word Count: 11277
English Abstract
French Abstract

Legal Status (Type, Date, Text) Publication 20011220 A2 With declaration under Article 17(2)(a); without abstract; title not checked by the International Searching Authority. Examination 20020502 Request for preliminary examination prior to end of 19th month from priority date

Detailed Description EVENT REVENUE MANAGEMENT SYSTEM CROSS REFERENCE TO RELATED APPLICATIONS This application elaims the benefit of U.S. Provisional Application No.
60/210,354, which was filed on June 9, 2000, and which is hereby incorporated by reference.

1/19/4 (Item 1 from file: 485)
DIALOG(R)File 485:Accounting & Tax DB

00770486 SUPPLIER NUMBER: 54170959
Forecasting for airline revenue management
Zaki, Hossam
Journal of Business Forecasting Methods & Systems v19 n1 PP: 2-6 Spring 2000
ISSN: 0278-6087 JRNL CODE: JBT
DOC TYPE: Periodical ARTICLE TYPE: Feature
LANGUAGE: English
WORD COUNT: 2865 LINE COUNT: 260

ABSTRACT: How revenue management is used in the airline industry is described. RM cannot work without adequate forecasts of capacity, demand and prices. Improvement in forecast accuracy significantly improves revenue. Revenue management techniques are essentially a set of balancing acts, each act or technique adds a small fraction to the airline revenue, and collectively they provide respectable increases.

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It is a common knowledge that the purpose of the airlines industry is to profitably move people from one airport to another. Although on the surface it looks very simple, it is very difficult to do it. Airlines have to make strategic and operational decisions, considering numerous factors and forecasts. Strategic decisions include such things as how many aircraft to buy (fleet sizing) and where to fly (network structure). These decisions are called strategic because they have a long-term impact on all aspects of the airline business, and they are costly to change. Elaborate market share projections and long-term demand forecasts are important inputs for such decisions. There are many cases where airlines got bankrupt because of ill-conceived strategic decisions.

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To address this question, we present a brief overview of what is revenue management in the airline industry. Then, we will highlight the importance of revenue management and forecasting accuracy.

REVENUE MANAGEMENT

The short answer to the question, "why forecast," is to support revenue management (RM). So, what is revenue management? The main objective of RM is to sell the right seat to the right customer at the right time for the right price to maximize profit. To achieve this, the airlines need to sell the optimum product mix. On the surface it might seem that the airlines sell one product, which is a seat on an airplane going from point A to point B. In fact, an airline sells numerous products. A single flight may have hundreds of fares each is associated with only one product. The underlying premise of the practice of revenue management is that there exists an optimum mix of products that can maximize the airline's profit. The mechanism the airlines use to capture this optimum product mix is simply the accept/reject decision made by the airline reservations system. It is important to note that this mechanism does not require adding new airplanes nor does it require adding more flights. It does not create additional demand and does not change the current prices. Instead, it strives to match the passengers' demand with the airline's supply of seats in such a way that maximizes the airline's profit from existing assets. The accept/reject decisions are typically based on the results of solving one or more optimization problems, collectively called the revenue management problem. The fundamental data components of the revenue management problem are price, demand and capacity. Forecasting helps to estimate these components.

FINANCIAL IMPACT

Revenue management significantly adds to the airlines' income. According to Robert Crandall, RM adds $500 millions a year to the income of American Airline. It adds about $100 millions to the income of United Airlines (UA). In general, airlines realize additional income as a result of RM anywhere between 1 % and 10%.

Forecasting accuracy plays a very important role in realizing income from the RM system. Studies show that a 10% reduction in forecast error increases revenue by 0.5%, $80 millions additional revenue a year for a $16 billion airline e.g. American Airline. America West has also reported similar results where a 25 % reduction in the error increased revenue by 1.4%.

RM TECHNIQUES

Revenue management techniques are essentially a set of balancing acts, each act or technique adds a small fraction to the airline revenue, and collectively they provide respectable increases, between 1 % and 10%. Here is a brief overview of some of the most important balancing acts performed by revenue management.

Overbooking: Passengers sometimes cancel their reservations, and other times they do not show up at all at departure time. Hence, if the airline sells 100 seats on a 100-seat flight, the airline will end up with unoccupied seats. An unoccupied seat on a flight is lost revenue that cannot be recovered. Hence, the airline has to overbook. That is, the airline has to sell more seats than the actual physical capacity to account for cancellations and no shows. However, we cannot overbook extensively. If we overbook too much, there will be more passengers showing up at the gate than seats available in the aircraft. In that case, the airline has to compensate with a voucher to passengers that will be denied boarding. Thus, the first balancing act of RM is to determine optimum overbooking limit, that is, how many seats to sell for every departure to account for cancellations and no shows.

Discount Allocation: Airlines sell discount fare tickets usually to price sensitive leisure travelers and full fare tickets to price insensitive, late-booking business travelers. The demand for discounted seats often exceeds capacity. If an airline does not protect seats for the late booking, then the revenue from high revenue business travelers will be lost. On the other hand, selling full fare tickets alone will not fill up the airplanes, thereby the airline will lose its market share to competitors' discount fare flights. Hence, the second balancing act of RM is to determine how many seats to sell at a discount fare and how many to save for high revenue passengers.

Origin-Destination Management: Airlines with hub and spoke structure have to distinguish between long haul and short haul traffic (passengers). A simple example is to consider 2 flights. Flight # 1 is from city A to city B. Flight # 2 is from city B to city C. In this example, passengers who fly from A to B to C are called long haul passengers (or traffic). Passengers who fly only from A to B are called short-haul passengers. Also, passengers who fly only from B to C are called short-haul

passengers. Obviously, long haul passengers are competing with short haul passengers on the seats of both flights. Airlines with hundreds of flights in and out of each hub every day have to determine the optimum seat allocation between short and long hauls that will maximize their profit. This "optimum" seat allocation, of course, depends on demand and price of all itineraries involved. Typically, long haul traffic yields higher revenue. Hence, the third balancing act of RM is to determine how many seats to sell to short haul passengers and how many to save for high revenue, long haul passengers.

Group Management: Travel agencies, tour operators, consolidators and wholesalers frequently request a reservation of a group of passengers. Sometimes, the group booking is a onetime ad-hoc request. Other times, it is a sequence of bookings, identical in every respect except the departure day. Wholesalers usually buy blocks of seats for every schedule. Groups are an attractive option for airlines because they can fill empty seats on low-demand flights, and because they generally book earlier than individuals. Due to their size and early booking pattern, groups request fares are lower than individual discount fares. The choice between groups and individuals is the fourth balancing act, which RM has to perform. Here, the airlines have to determine how many seats to sell to groups at what price so that adequate numbers of seats are left for higher revenue, later booking customers. An important attribute of group-booking fares is that they are typically negotiated, this complicates the group accept/reject decision and necessitates adding additional modules to the RM system for group revenue management.

Point of Sale Management: Managing ticket distribution is of significant importance to the airlines' bottom line. Traditional sales channels such as travel agencies and airlines ticket offices are now challenged with new Internet channels such as airline web sites (e.g. Travelocity) and auction or bid sites (e.g. Priceline). Before the Internet era began, many airlines distribution costs were up to 20 % of the price of a ticket. Currently this number is around 16%. Airlines are striving to get it down to as low as 6% using smarter methods to control the volumes allocated to different sales channels. Although commission fee is the main component of distribution costs, currency stability is also an important concern for international tickets. Airlines have to account for currency fluctuations. As such, it limits the sales made in less stable foreign currencies.

WHAT TO FORECAST

As stated above, we need to forecast capacity, demand and prices. By far demand forecasting is the most challenging part. Capacity forecast would have been a straightforward exercise if it were not for cancellations and no shows. Prices would also have been much simpler if the price data was available with the booking requests. DEMAND

Similar to any other industry, the airline industry forecasts demand for each product it sells. In fact, the airlines created these products in order to increase its revenue. To support revenue management, mean and variance of each product demand are needed. For RM purposes, the main attribute that defines a product is that it has one price (i.e. fare). Factors that affect airline fares include time of purchase, trip's origin -destination, one way or round trip, individual or group, season, time of day, day of week, Saturday stay over, point of sale and membership of the airline's frequent flyer program. At any point of time, each combination of these attributes can represent a single product with a single price. As such, mean and variance for each product demand are required.

BOOKING PROFILES

The airline industry is one of very few industries that have a unique asset in forecasting product demand. That asset is the reservation data. Typically, most airlines open a flight for bookings almost one year before departure, and during that time useful reservation data is accumulated. The time between starting to accept bookings and flight departure is called the booking horizon. A booking profile (or a booking pattern or a fractional build curve) is a chart that depicts the percentage of bookings over the booking horizon of a flight. Almost all RM forecasting modules assume that one or more attributes of historical booking profiles will repeat in the future. This fundamental assumption plays an important role in projecting the future demand and guiding the essential accept/reject decisions during the booking horizon of each flight.

SHOW-UP RATES

Show-up rate is the ratio between number of passengers who will show up at the time of departure to the total number of bookings at any point in the flight's booking horizon. The show-up rate can be an attribute of a flight or a product. In general, a flight show-up rate deviates from 100% due to one of three reasons: cancellations, no shows and walk-ins. Cancellations are no-shows with a notification before departure. Walk-ins are passengers who want to board the flight and have no prior reservation. Estimates of these three rates are required to determine overbooking.

FARE FORECAST

One of the most surprising aspects of airline booking data is its lack of price data. That is, when a reservations system receives a booking request, say from a travel agent, it does not specify the dollar amount associated with the request. RM systems are hence forced to forecast the fare associated with each booking request using historical coupon (ticket) data of similar bookings.

CHALLENGES

Compared to many other industries, the passenger airline industry has the best data in terms of volume, length of history and quality. Despite these, it faces many challenges which we will describe next.

DYNAMIC NATURE OF RM

If all data components, demand, supply and price are static and known in advance, the problem will be reduced to an integer program that can be solved using off-the shelf solvers. However, in practice, there are many challenges. One challenge is the dynamic nature of the problem. For example, in the airline industry, price for a certain product can change several times a day in response to competition. Another example is that customer demand and showup rates are at best stochastic and cannot be easily modeled using only the mean.

RESERVATIONS SYSTEMS LIMITATIONS

There are numerous examples of how the limited capabilities of the current airline reservation systems affect the ability of an airline to realize full potential of revenue management. The issue on hand is the availability, quality and stability of the problem data in electronic form. The magnitude of this challenge changes from one airline to another depending on the sophistication of the airline's reservation system. Here we give few examples that are directly related to forecasting.

Most reservations systems store only data on accepted bookings and do not store historical information about rejected demand. RM requires projections of total untruncated demand as well as what was accepted.

Some reservation systems do not carry point of sale data with a booking request. This weakens the effectiveness of managing revenue by distribution channel.

Most reservations systems do not carry fare data with a booking request. As mentioned above, this makes RM systems to forecast fares and then add the risk of fare with a forecasting error. Some reservations systems store demand history only by flight legs (nonstop flights between 2 points), not by the journey's origin and destination (OD). This makes origin-destination management much more difficult. For example, a flight from Dallas to Chicago may have passengers with numerous OD's, e.g. Houston to Chicago through Dallas, Dallas to London through Chicago, Dallas to Toronto through Chicago, and so on. But the reservation system provides information only on the number of passengers on a specific flight from Dallas to Chicago and not on the number of passengers by OD.

Some reservations systems cannot control round trips. All data is one-way based. This makes it difficult to differentiate between one-way and round trips.

SCHEDULE CHANGE

Most carriers have 2 major schedule changes (summer and winter) a year. These changes affect a significant percentage of the flights that is estimated to be between 10% and 20 %. There are several possible schedule changes:

Change in time of departure Splitting a flight of one big airplane into two flights in smaller airplanes

Adding a new flight

Changing a flight number

If not treated properly, schedule change affects demand forecast accuracy in a negative way. The new schedule for which we need to forecast demand is different from the old schedule for which we have historical data. The challenge is to relate the demand for the current schedule to that of the old schedule.

PROBLEM SIZE

The number of forecasts required depends on the number of products and legs. For every product, we need mean and variance of the product demand and associated fare. For each leg, we need capacity. Depending on the overbooking model used, we need show-up rates either by leg or product.

Large airlines can have millions of products to forecast. In March 1998, United, the largest airline in the world, has announced its new $18 million demand forecasting system, dubbed Orion. The system supports origin-destination (OD) forecasting. Previously, United used its MVS mainframe to run its leg forecasting system. But when the airline wanted to analyze data more thoroughly at the OD level, the mainframe couldn't keep up. Due to a significant increase in the size of problem, United turned to parallel processing, and chose a RS/6000 SP2 system from IBM Corp with 47 processors that can be expanded to 512 processors and can even be linked to a second RS/6000.

CONCLUSIONS

Forecasting is an important component of airlines' revenue management. To support revenue management techniques, airlines have to forecast demand, supply and fares accurately. Forecast accuracy has a direct impact on the airline's bottom line. However, there are many challenges to achieve the desired level of accuracy. Revenue management researchers and analysts are developing new solutions to face these challenges.

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GEOGRAPHIC NAMES: United States; US
DESCRIPTORS: Revenue; Forecasting techniques; Airline industry; Accuracy
CLASSIFICATION CODES: 3100 (CN=Capital & debt management); 8350 (CN=Transportation & travel industry); 9190 (CN=United States);

NEW SEARCH

Set	Items	Description
S1	31	(RECORD OR HIGHER OR LOWER)(1W)(TICKET OR TICKETS)(1W)(SALES OR SOLD) AND (TEAM(1W)RECORD)
S2	12	S1 AND PD<20000608

2/9/5 (Item 1 from file: 706)
DIALOG(R)File 706:(New Orleans)Times Picayune

10606072
AL NOTES
New Orleans Times Picayune (NO) - Saturday, April 15, 2000
By: Compiled from wire reports
Edition: ORLEANS Section: SPORTS Page: D05
Word Count: 810

TEXT:
ANGELS: Outfielder Garret Anderson agreed to a four-year contract extension through 2004, the team said. Anderson, 27, is hitting .250 with one home run and a team-high 10 runs batted in this season. He became the team's starting left fielder when Jim Edmonds was traded to St. Louis on March 24. Anderson had one of his best seasons in 1999, matching his career-best with a .303 average, and setting career-highs with 21 homers, 88 runs scored, 291 total bases and 157 games played. Financial terms of the extension weren't disclosed. ... After nine straight games at home, Friday night's was the first of 10 straight on the road for the Angels.

ATHLETICS: First baseman Jason Giambi pulled up lame running out an RBI groundout against Boston on Friday night and left the game with a hyperextended right knee. Giambi was expected to be examined after the game. No other information about the injury was immediately available. .. It was Oakland's first road game of the season after going 3-6 on their opening home stand.

BLUE JAYS: LHP David Wells, who shut out Texas in his last start, matched the shortest outing of his career -- one inning. He gave up consecutive singles before Edgar Martinez hit a 426-foot homer to give Seattle a3-0 lead. After a walk and a single, Dan Wilson hit another three-run homer. Wells (1-1) walked straight to the clubhouse after ending the bottom of the inning with a strikeout. ... The Blue Jays have lost six straight games to the Mariners. ... There have been 18 home runs hit in five games at SkyDome.

DEVIL RAYS: Tampa Bay hasn't won two straight since a three-game winning streak last Sept. 25-27 at Yankee Stadium. ... Friday's game in Detroit was the Devil Rays' first outdoors this season. All their previous games were at Minnesota or Tropicana Field.

INDIANS: The Rangers (17-13) and the New York Yankees (21-9) are the only opposing teams with winning records at The Jake. ... Jim Thome, who stranded 10 runners at Oakland on Monday night when the A's played three infielders on the right side, unsuccessfully tried to bunt his way on in the first when the Rangers shifted against the pull hitter. ... Reliever Tom Martin committed just the Indians second error this season.

ORIOLES: Cal Ripken singled his first time up at the Metrodome on Friday night, moving with three hits of 3,000. With one out in the Baltimore second, Ripken fisted an inside fastball into right field off Minnesota Twins left-hander Eric Milton.

RANGERS: RHP Rick Helling, who entered Friday's gamewith a 7.84 ERA at Jacobs Field, held the Indians to two runs and four hits in eight innings in earning a 7-2 victory. He struck out nine.

RED SOX: Red Sox third baseman Gary Gaetti retired before the game and was replaced on the roster with infielder Andy Sheets. ... Shortstop Nomar Garciaparra had his first two-error game since Game 1 of the AL Championship Series last year against the New York Yankees.

ROYALS: Kansas City had been 12-for-12 on stolen base attempts until Carlos Febles was thrown out at second in the first inning against New York.

TIGERS: Detroit has set a franchise record for season-ticket sales with more than 17,000, about 5,500 more than the record set last year, the team announced Friday. The record was set even though the average cost of a ticket increased 103 percent this season, from an average of $12.23 at Tiger Stadium last year to $24.83 at Comerica Park. The Tigers said they have sold 1.75 million tickets this season, surpassing the year-end total for nine of the past 11 seasons. The team record for ticket sales was 2,704,794 in 1984, when the Tigers last won the World Series. The Tigers sold 2,026,441 tickets last season, the most they had sold since 1988.

WHITE SOX: The most visible addition to Comiskey Park is the giant billboard behind the left-field bleachers that is a stock ticker. ... The game was the first of a 13-game home stand for the White Sox, who spent their first two weeks on the road. ... The White Sox opened the season with an average age of 26.8 years, tying them with the Twins for the youngest roster in the AL.

YANKEES: The Yankees have homered in eight of nine games this season. ... Chuck Knoblauch, who popped to third with the bases loaded and one out in the fifth, has no RBIs in 41 plate appearances this season. He made his second error, fumbling an eighth-inning grounder. ... RHP Roger Clemens tied Vic Willis for 39th on the career list with 248 wins. St. Louis' Bob Gibson is next at 251.

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